results produced by artificial selection are taken as examples of what would take place in nature under the assumed circumstances; and this "natural selection" is proposed as a sufficient explanation of the appearance of "a race which conchologists would call a distinct species."

The author states also, referring to Mr. Bakewell, "I have heard him say, that he scarcely knew any assignable limits beyond which these changes, both external and internal, might not be carried" (p. 402). Another statement is interesting as showing that Charles Darwin doubtless knew of this Mr. Bakewell, and may have heard him discuss these matters in his boyhood. In a footnote (p. 403) we read, "Mr. Bakewell of Dishley was in a considerable degree self-educated; but he possessed a strong original mind, which was enlightened by study and meditation. He was also a man of great moral worth, and was intimately acquainted with Dr. Priestley, Dr. Darwin, and other eminent philosophers who inhabited the central part of England, towards the close of the last century. The late Countess of Oxford once asked the author of the present work, *whether he was related to the Mr. Bakewell who invented sheep*. He replied that he was of the same Leicestershire, or originally Derbyshire family,"

It appears from these quotations that "the Mr. Bakewell who invented sheep," and the Mr. Bakewell, author of 'Introduction to Geology,' were true Darwinists before Charles Darwin. And who can tell how much of Mr. Bakewell's theory of natural selection was transmitted to the youthful Darwin through the delicious mutton of the Leicestershire Downs? H. S. WILLIAMS.

Cornell University, Nov. 3.

'Bi-daily.'

THE *Monthly Weather Review* of the Signal Service for August contains the term 'bi-daily,' as applied to the present system of indications, which are now made twice each day. That this is an incorrect use of the prefix 'bi' may be discovered by consulting a dictionary, or by reflecting upon its derivation.

The prefix 'bi' doubles the word to which it is prefixed. A biennial election is a two-yearly election, i.e., once in two years; and a bi-daily observation is an observation made every two days.

An event occurring twice each day is half-daily or semi-daily, the same as a semi-annual dividend or a half-yearly payment.

The word 'tri-daily,' which is applied to the signal-service observations, has attained by usage the meaning 'three times a day,' because of the lack of any other simple prefix. But the extension of this improper usage to the prefix 'bi' can have no warrant, since we have the correct prefix 'half' or 'semi,' both of which are already in common use. GEO. E. CURTIS.

Topeka, Kan., Nov. 1.

Buffalo on the Texas Plains.

THE re-opened discussion of the buffalo question calls for a few statements concerning these animals in Texas. Two hundred head or more of these animals may be found in the Panhandle of Texas, on the Llano Estacado, and in No-Man's Land. Some are on the Palo Duro Cañon ranch, owned by Capt. Charles Goodnight; others in the Texas Capital Syndicate, or XIT pasture, especially on the North Plains, i.e., north of the Canadian River; still others are at large. Probably twenty or more buffalo calves were captured this spring in that region and driven to Kansas for mercenary and breeding purposes. The cow-boy's ideal, like that of the more 'refined' sportsmen, is to shoot these cattle at sight, but the proprietors of the ranches are doing much for their protection.

There are also many buffalo on the South Plain. The antelope, black-tailed deer, and many rare but smaller mammals, are found in the same region — all of which I saw or heard of during a recent visit to Plaza Larga, Tucumcarri Mesa, and the Texas Panhandle. Naturalists desiring these forms should go to Tascosa, Tex., near the New Mexican line, a place easily accessible from Kansas, Denver, and Texas, *via* the Fort Worth and Denver Railway. The capture of wild horses is a profitable pursuit in this region.

ROBT. T. HILL.

University of Texas, Austin, Nov. 7.

Answers.

37. WHAT NUMBERS DOES IT TAKE TO MAKE A BILLION? —Responding to Query 37 (*Science* xii. 204), 'What numbers make a billion?' I would offer the following remarks: The term 'billion' appears to have been introduced by the Italian arithmeticians early in the fourteenth century. Peacock, in his admirable history of arithmetic (*Encyclopæd. Metropol.*, vol i.), states that the Italians made "a great addition to their former numerical language by the use of the word 'millione' (which properly signifies 'great thousand') to denote the square of one thousand; and which was followed by the words 'billione,' 'trillione,' etc., deduced immediately from the form by pursuing the natural analogies of the language: a series of numerical terms was thus formed, proceeding not by tens, but by millions." The new terms were slowly adopted by the nations of Europe, but in every case in their original and etymological sense.

In Spain these terms were used probably not long after their establishment in Italy; in France they were adopted not much before the opening of the sixteenth century; in Germany, early in the sixteenth century; in England, not till the close of the seventeenth century; and in Russia, early in the eighteenth century. Locke, who published his great essay in 1690, complains that his countrymen were accustomed to speak of millions of millions of millions instead of using the more convenient term 'trillions;' and he gives an example of the proper notation to sixty places of figures, divided into sextuple periods, and duly named up to nonillions. "The ordinary way of naming this number in English will be the often repeating of millions of millions of millions of millions," etc. (*Human Understanding*, book ii. chap. 16, sect. 6). It is important to observe, that, wherever introduced, the term 'billion' uniformly designated the *bis* power of the million, — a value, the prefix to twelve places of figures. In the Italian dictionary of the Accademici della Crusca, the word 'bilione' (or 'billione') is defined, "un milione di milioni." In the Spanish dictionary of the Academia Española, the word 'billon' is defined, "un millon de millones," or a million multiplied by itself. In the German dictionary of Dr. Daniel Sanders, 'billion' is defined, "millional million." And in Littré's 'French Dictionary,' after defining the word, it is stated, "The forms billion, trillion, etc., were devised in the sixteenth century to signify periods of six to six figures: counting from the right, units were represented by the first six places of figures, the millions were represented by the figures from 7th to the 12th places, the billions were represented by the figures from the 13th to the 18th places, and so on." Est. De La Roche's 'Arithmetique' is quoted as stating, "A billion is equal to a million million." Littré adds (without explanation), "It was not till the middle of the seventeenth century that the rule of separating into periods of six, was changed to separating into periods of three figures, and the original *billion* was divided by 1,000." It is not a little surprising that our compilers of school arithmetics (whether smitten with Francomania or with Anglo-phobia) have almost unanimously adopted the modern French perversion of the terms 'billion,' 'trillion,' etc. And thus business-men are in the habit of numerating '-illions' by places of three (*after the million place*), while astronomers and mathematicians preserve the original and logical numeration by places of six figures. It needs but a bare inspection of the terms themselves to see that this French neologism (of the last two centuries) is not only anomalous, but wholly irrational. The form of the words 'million,' 'billion,' 'trillion,' 'quadrillion,' 'quintillion,' etc., necessarily denotes some co-ordination of numerical progression. What can it possibly be on the pedagogue's system? The expression 1 000, 000 000 (one thousand million) does not admit any logarithmic bisection. How can it, then, be in any sense a *billion?* If it be any kind of a *bis*, what is its primary? It is an impossible second power, having a surd for its root. Had the French arithmeticians cut down at the same blow the *million* to the *mille*, the scheme would at least have been consistent. A true billion is evidently a *second* order of million, and the only rational order is the second power.

To any reflecting mind the school-book numeration is simply absurd, and its prevalence is a very puzzling phenomenon.

W. B. T.

Washington, D.C., Oct. 30.